

The bird communities of Berry Jerry State Forest and The Rock Nature Reserve near Wagga Wagga, New South Wales in 1975-1981 and 1995-2003

Michael J Murphy

Blackbird Grange, 2 Rundle Street, Coonabarabran NSW 2357

Abstract

A study of the bird communities of two public reserves near Wagga Wagga on the NSW South Western Slopes recorded 127 species including 26 woodland species considered to be declining in the region (seven of which are currently listed as threatened under NSW state legislation) and 49 woodland species at risk of decline, as well as a range of agricultural species and waterbirds. Ninety-three species were recorded in Berry Jerry State Forest and 108 species in The Rock Nature Reserve, with 74 species found in both. Differences between the bird communities of the two reserves are in part a reflection of the different habitats available, with Berry Jerry State Forest supporting a diverse aquatic bird community in addition to the terrestrial bird community. Species in the 'declining' and 'at risk' categories made up approximately two thirds of the terrestrial bird communities of both reserves, and both reserves are considered to be close to losing a number of these species. Comparison of records from 1995-2003 and 1975-1981 suggests that Berry Jerry State Forest may have lost four species of its declining woodland bird community (Speckled Warbler *Chthonicola sagittata*, Eastern Yellow Robin *Eopsaltria australis*, White-browed Babbler *Pomatostomus superciliosus* and Diamond Firetail *Stagonopleura guttata*) over the past two decades. Both Berry Jerry State Forest and The Rock Nature Reserve are considered to be of regional significance for bird conservation. A combination of local- and regional-scale management actions is necessary if they are to maintain viable bird communities. (*The Victorian Naturalist* 124 (1), 2007, 4-18).

Introduction

The New South Wales (NSW) South Western Slopes Biogeographic region (Thackway and Creswell 1995), in inland southeastern Australia, has been extensively modified over approximately 18 decades of European occupation to become one of Australia's primary agricultural and pastoral regions. An estimated 84% of the region's original temperate woodland and forest has been cleared (Pressey *et al.* 2000) and the modern landscape is a variegated patchwork of cropped areas, grazing lands of native or improved pasture (with or without scattered senescent trees) and small woodland/forest remnants, typically on poorer soils (Morgan and Terrey 1992; Sivertsen 1993; Murphy 1999; Gibbons and Boak 2002). Together with other parts of southern Australia's sheep-wheat belt, the region today faces serious issues of declining agricultural productivity (through processes such as soil erosion and salinity) and declining biodiversity (Saunders 1994; Robinson and Traill 1996; Barrett 1997; Reid 1999).

While some native bird species such as the Crested Pigeon *Ocyphaps lophotes*, Galah *Cacatua roseicapilla*, Noisy Miner

Manorina melanocephala and Australian Magpie *Gymnorhina tibicen* are able to survive or even thrive in the modern agricultural landscape of southern Australia's sheep-wheat belt (Grey *et al.* 1997; Recher 1999; Reid 1999), many others depend wholly or in part on the remaining remnants of the original vegetation. Recent studies and reviews have indicated that a large proportion of the birds dependent on Australia's temperate woodlands is in rapid decline with a continuing wave of local and regional extinctions (Saunders 1989; Barrett *et al.* 1994; Robinson and Traill 1996; Reid 1999; Traill and Duncan 2000). Robinson and Traill (1996) estimated that more than one quarter of all terrestrial bird species found in Australia's temperate woodland regions were currently affected. Threatening processes driving this ongoing decline include a combination of continued clearing of remnant woodland habitat, extinction debt (where relictual populations isolated in remnants too small to sustain them decline over time to eventual local extinction) and ongoing degradation and disturbance of remnant areas



Apostlebird *Struthidea cinerea*: a declining woodland bird species. Photo by Michael Murphy.

through over-grazing by domestic stock, weed invasion, increased predation or competition by feral animals or disturbance-tolerant native species, firewood collection, pollution with agricultural chemicals, tree dieback and inappropriate fire regimes (Ford 1985; Saunders 1989; Benson 1991; Robinson and Traill 1996; Traill and Duncan 2000).

Only about 1% of the NSW South Western Slopes region has been set aside in formal conservation reserves (State of the Environment Advisory Council 1996; Pressey *et al.* 2000), and additional areas of remnant native vegetation occurring on freehold properties and on public lands such as state forests and travelling stock reserves make a significant contribution to supporting regional biodiversity. The present study examined the local bird communities occurring in two public land woodland/forest remnants on the NSW South Western Slopes; one a formal conservation reserve and the other a state forest. The results from the present study were also compared with information from a similar study two decades earlier. Studies such as

this are useful in providing a local, site-specific perspective to regional-scale patterns of change in bird communities.

Methods

Study areas

The two study areas (Figs 1-3) were Berry Jerry State Forest (SF) and The Rock Nature Reserve (NR), near Wagga Wagga in Wiradjuri Aboriginal Country in the NSW South Western Slopes bioregion.

Berry Jerry SF (35° 03'S, 147° 03'E), dedicated in 1915 and currently 1199 ha in area, is managed by Forests NSW (now part of the NSW Department of Primary Industries). It is located approximately 25 km west of Wagga Wagga on alluvial soils of the Murrumbidgee River floodplain. Beavers Creek (an anabranch of the Murrumbidgee River) runs through the reserve and, together with associated wetlands, provides extensive aquatic habitat. The vegetation of the reserve is predominantly riverine forest of River Red Gum *Eucalyptus camaldulensis* with an understorey of grasses and herbs. Large mature trees with abundant hollows are common along the banks of Beavers Creek.

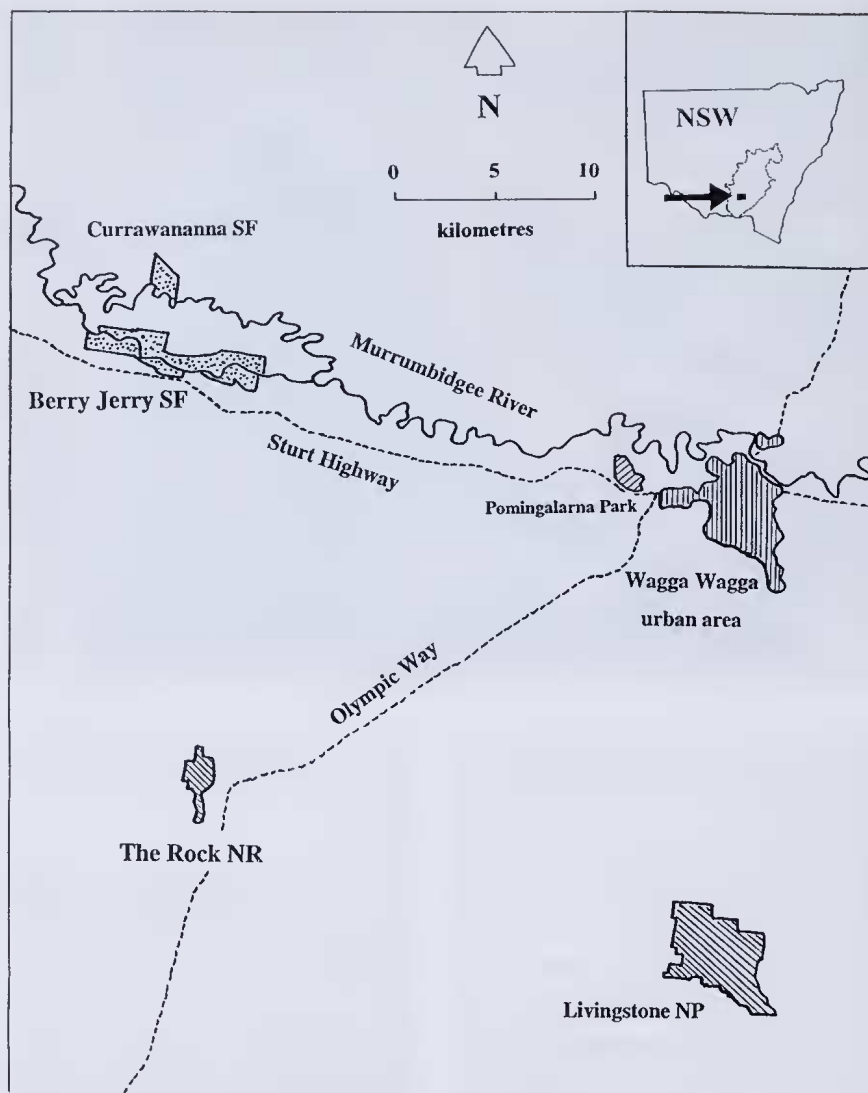


Fig. 1. Location of Berry Jerry State Forest and The Rock Nature Reserve near Wagga Wagga in the NSW South Western Slopes Biogeographic Region. Additional reserves mentioned in the text are also shown.

Approximately 50 ha of grassy open woodland of Grey Box *E. microcarpa*, Yellow Box *E. melliodora* and White Cypress Pine *Callitris glaucophylla* occurs on slightly higher ground in the south of the reserve. Domestic sheep and cattle graze throughout the reserve. Fallen timber remains common despite widespread evidence of timber removal.

The Rock NR (35° 16'S, 147° 04'E), gazetted in 1962 and currently 341 ha in area, is managed by the NSW National Parks and Wildlife Service (NPWS) (now part of the NSW Department of Environment and Conservation). It is located approximately 30 km south-west of Wagga Wagga and comprises a steep

rocky ridge of Devonian quartzite and slate rising about 360 m above the surrounding agricultural countryside. The lower slopes of the Reserve (extending into adjacent freehold properties and a travelling stock reserve) support woodland dominated by Grey Box, White Box *E. albens* and Blakely's Red Gum *E. blakelyi*, with White Cypress Pine, Black Cypress Pine *C. endlicheri* and Red Stringybark *E. macrorhyncha* also present, and a sparse understorey of grasses and shrubs. Higher, steeper slopes in the Reserve support woodland of mainly White Box and Currawang *Acacia doratoxylon* with a heathy understorey, while the ridge top supports Currawang, Dwyer's Mallee Gum *E. dwyeri* and Hill Oak *Allocasuarina verticillata* (Burrows 1999; NPWS 2000). Exposed cliff faces provide nesting and roosting sites for various bird species. Aquatic habitat is limited to a small dam (about 100 m² surface area) on the lower slopes of the reserve and additional stock dams on adjoining properties. Domestic stock is excluded from the reserve and the area is managed for conservation.

Survey methods

A field survey of the bird species found in the two study areas was done during four visits to the Wagga Wagga area by the author between January 1999 and July 2003, with one visit occurring in each season. Berry Jerry SF was visited on a total of 14 days and 9 nights during this period, while The Rock NR was visited on 12 days and 3 nights. Diurnal birds were identified by sight or call while walking by day in a random meander through the different vegetation communities present, with 7 x 50 binoculars used to aid observation. Birds with unfamiliar calls were tracked down and identified by sight. Nocturnal birds were identified by sight or call while walking or slowly driving through the study areas at night with a 50 watt spotlight. The species recorded during each field visit were each assigned to one of four categories of abundance, based on the number of individuals or family groups recorded: abundant (more than 50 records), common (15-50 records), uncommon (3-14 records) and rare (1-2 records). The assigned categories were then averaged over the four

visits to generate a final category of abundance for each species in each reserve. The results of the field survey were supplemented with records of additional species from the NPWS Atlas of NSW Wildlife and the Birding-Aus internet mailing list archive (<http://www.cse.unsw.edu.au/birding-aus>) for the period 1995-2003.

The records of Gall (1982), which documented the results of a regional survey of the vertebrate fauna of the South Western Slopes in the late 1970s-early 1980s, were examined and bird records for Berry Jerry SF and The Rock NR retrieved. Gall's survey methods for birds were similar to those employed in the present study, comprising diurnal observation, call recognition and spotlighting, and included 4 days of field survey in Berry Jerry SF and 13 days in The Rock NR between 1977 and 1981 (Gall 1982). Data from Gall's report were supplemented with records of additional bird species from the two study areas for the period 1975-1981 from the NPWS Atlas of NSW Wildlife.

Ecological categories

Species recorded were divided into the following four categories:

- 1) species dependent on aquatic habitats;
- 2) species dependent on woodland or forest habitats and considered to be currently declining in the eastern Australian sheep-wheat belt, including species currently listed as threatened under the NSW *Threatened Species Conservation Act 1995* (TSC Act);
- 3) species of woodland/forest habitats considered to be marginally secure with a risk of decline in the future as a result of dependence on woodland or forest areas; and
- 4) species of agricultural habitats, comprising both woodland/forest species considered to be relatively tolerant of clearing and fragmentation, together with species from open country habitats.

Assignment of species to the three terrestrial categories was based on review of available references to the status of birds in eastern Australian temperate woodlands; primarily Reid (1999) and Traill and Duncan (2000), but also Loyn (1985), Barrett *et al.* (1994), Robinson (1994), Robinson and Traill (1996), Barrett (1997),



Fig. 2. River Red Gum riverine forest in Berry Jerry State Forest. Uncontrolled grazing by domestic stock is a likely factor in the apparent loss of four declining woodland bird species from this reserve, but strategic grazing is now being used in an effort to replace introduced weeds with native grasses. Photo by Michael Murphy.



Fig. 3. View from the summit of The Rock Nature Reserve, illustrating the context of this small woodland reserve in the modern agricultural landscape of the NSW South Western Slopes. Photo by Michael Murphy.

Bennett and Ford (1997), Egan *et al.* (1997), Murphy (1999) and Reid (2000).

Results

A total of 127 species was recorded in this study (both study areas and both survey periods combined), comprising 123 native species and 4 introduced species. Ninety-three species were recorded in Berry Jerry SF and 108 species in The Rock NR, with 74 species found in both. A complete list of the species recorded is provided in Appendix 1, together with information on when and in which study area each species was recorded and the abundance category for those species recorded in the 1999-2003 field survey.

The 1999-2003 field survey recorded 75 species in Berry Jerry SF, with two species (the Galah and Sulphur-crested Cockatoo *Cacatua galerita*) recorded as abundant, 16 as common, 26 as uncommon and 31 as rare. Table 1 shows the cumulative total of species recorded over the four visits comprising the 1999-2003 field survey. The rate of increase in Berry Jerry SF had slowed by the 4th visit, with only 5% of the species added at that time, suggesting that few additional species remained to be found. Reference to the NPWS Atlas of NSW Wildlife and the Birding-Aus internet mailing list archive indicated no additional species for the study area for the period 1995-2003. Seventy species were recorded in Berry Jerry SF in the period 1975-1981; 62 species by Gall (1982), with records of another eight species from

the NPWS Atlas of NSW Wildlife. Fifty-two species were recorded in Berry Jerry SF during both 1975-1981 and 1995-2003, while 18 species were recorded only during 1975-1981 and 23 only in 1995-2003 (Appendix 1).

The 1999-2003 field survey in The Rock NR recorded 80 species. No species were recorded as abundant, 18 were common, 29 were uncommon and 33 were rare. The cumulative total over the four visits of the field survey (Table 1) shows that 10% of the species were first recorded at the 4th visit, suggesting that the species list for The Rock NR was not as close to completion as that of Berry Jerry SF, with additional species probably remaining to be found. Reference to the NPWS Atlas of NSW Wildlife and the Birding-Aus internet mailing list archive identified an additional 12 species for the study area for the period 1995-2003, bringing the total for that period to 92 species. Eighty-nine species were recorded in The Rock NR in the period 1975-1981; 65 species by Gall (1982), with records of another 24 species from the NPWS Atlas of NSW Wildlife. Seventy-three species were recorded in The Rock NR during both 1975-1981 and 1995-2003, while 16 species were recorded only during 1975-1981 and 19 only in 1995-2003 (Appendix 1).

The number of species recorded in each of the four ecological categories is summarised in Table 2. Species of aquatic habitats comprised 16% of the total bird

Table 1. Cumulative total of bird species recorded during 1999-2003 field survey.

	Jan 1999	Apr 2001	Oct 2002	Jul 2003
Berry Jerry SF	40	53	71	75
The Rock NR	29	49	72	80

species recorded in Berry Jerry SF but only 3% in The Rock NR. Species in the 'declining' and 'at risk of decline' categories together made up about two thirds of the terrestrial bird species of both study areas. Berry Jerry SF had 19 species identified as declining woodland species, while 24 declining woodland species were recorded at The Rock NR. Seven threatened bird species (all currently listed as vulnerable under the TSC Act) were recorded during the 1999-2003 field survey, two species in Berry Jerry SF and six species in The Rock NR. One species, the Brown Treecreeper (Fig. 4), was recorded in both study areas, although there is uncertainty whether the form present was the threatened eastern subspecies *Climacteris picumnus victorae* or the unlisted inland and nominate subspecies *Climacteris picumnus picumnus*, as the Wagga Wagga area lies within the zone of intergradation between the two (Schodde and Mason 1999). Additional information concerning observations of threatened species during the field survey is summarised in Table 3.

Discussion

This study demonstrated that both Berry Jerry SF and The Rock NR are of significant conservation value. Avian values of Berry Jerry SF identified in the present study include extant populations of 15 species of declining woodland birds (including two threatened species) and 25 woodland bird species at risk of future decline, complemented by a range of agricultural birds and waterbirds. The threatened Superb Parrot *Polytelis swainsonii* is likely to breed in Berry Jerry SF, given the proximity of known breeding sites and the abundance of suitable nesting hollows along Beavers Creek (Webster and Ahern 1992; Leslie 2005). Brown Treecreepers remain relatively common and widespread in the reserve. Berry Jerry SF also supports other significant fauna, such as the threatened Squirrel Glider *Petaurus norfolcensis*

(Murphy pers. obs. April 2001). None of the waterbirds recorded in Berry Jerry SF is considered of current conservation concern, although the continued restriction of natural flood events as a result of river regulation and extraction of water for agriculture, combined with continuing loss of mature riverine forest in the region, may see this change in the future (Frith 1982; Briggs and Thornton 1999). Current management of Berry Jerry SF aims to assist protection of biodiversity. Forestry prescriptions in the reserve require the retention of all large trees greater than 170 cm diameter at breast height and a proportion of all hollow-bearing trees, including all those within 20 m of Beavers Creek or identified as nesting sites for endangered fauna (Forestry Commission of NSW 1986). Firewood collection is regulated by a permit system. Grazing by domestic stock is managed under a strategic grazing plan (involving increased stocking rates in winter to coincide with annual pasture growth and seeding and destocking over summer to allow native perennials to set seed) in an effort to control introduced species and favour native grasses (Leslie



Fig. 4. Brown Treecreeper *Climacteris picumnus*: a threatened woodland bird species. Photo by Marc Irvin.

Table 2. Number of species recorded in four ecological categories (1975-1981 and 1995-2003 survey periods combined).

	Aquatic habitat species	Declining woodland species	Woodland species at risk of decline	Agricultural species	Total
Berry Jerry SF	15	19	32	27	93
The Rock NR	3	24	47	34	108

Table 3. Summary of threatened bird records from 1999-2003 field survey.

Species	Summary of observations
Superb Parrot <i>Polytelis swainsonii</i>	Recorded in Berry Jerry SF in October 2002: flock of 8 birds (both sexes) feeding on mistletoes in Box woodland and single male in tree in River Red Gum forest.
Turquoise Parrot <i>Neophema pulchella</i>	Recorded in The Rock NR in January 1999 (2 birds in eucalypt tree in woodland on steep upper slopes) and April 2001 (flock of 8 birds feeding on ground with Red-rumped Parrots in Box woodland on lower slopes).
Brown Treecreeper <i>Climacteris picummus</i>	Common and widespread in River Red Gum forest in Berry Jerry SF, often associated with fallen timber. Recorded every visit. Also recorded every visit in The Rock NR but only seen in relatively flat areas on lower slopes.
Speckled Warbler <i>Chthonicola sagittata</i>	Small numbers (2-5) seen on each visit to The Rock NR. Foraging on ground in groups of 2-4 in woodland on lower slopes.
Hooded Robin <i>Melanodryas cucullata</i>	Single bird (male) seen in woodland on lower slopes of The Rock NR in April 2001.
Grey-crowned Babbler <i>Pomatostomus temporalis</i>	Small groups foraging on ground, fallen timber and lower trunks of Box trees in Box-Cypress Pine woodland on lower slopes of The Rock NR and adjoining freehold property in October 2002 (group of 6 birds) and July 2003 (group of 4 birds).
Diamond Firetail <i>Stagonopleura guttata</i>	Single record in woodland on lower slopes of The Rock NR in April 2001.

2000). Berry Jerry SF has been described as the most significant remnant of River Red Gum riverine forest in the Wagga Wagga local government area and one of the most significant in the NSW South Western Slopes region (NPWS 2003). Riverine forests provide the best opportunities for recreating linkages across regional landscapes in the eastern Australian sheep-wheat belt (Reid 1999), and Berry Jerry SF would constitute a significant node in a reconstructed and restored Murrumbidgee regional riverine wildlife corridor.

The woodland bird community of The Rock NR was found to be more diverse than that of Berry Jerry SF, with 23 declining woodland bird species (including six threatened species) and 36 woodland bird species at risk of future decline recorded there since 1995. Additional fauna species of conservation significance known from

The Rock NR include the threatened Squirrel Glider and Eastern Long-eared Bat *Nyctophilus timoriensis* (NPWS Atlas of NSW Wildlife) and the regionally significant Inland Carpet Python *Morelia spilota mectalei* (Murphy and Murphy in press). Conservation of the native flora and fauna is a primary management objective for The Rock NR. Activities such as domestic stock grazing and timber removal are prohibited, weed invasion is monitored and controlled and recreational usage is managed to minimise adverse impacts (NPWS 2000).

Differences between the avian communities of Berry Jerry SF and The Rock NR are in part simply a reflection of differences in the vegetation communities present and habitats available in the two areas. The extensive aquatic habitat present in Berry Jerry SF, for example, supported a wide range of waterbirds including ducks,

cormorants, pelicans, dotterels, herons, ibises and spoonbills, while the small area of aquatic habitat available at The Rock NR supported only low numbers of just a few waterbird species. Similarly, the Yellow Rosella *Platycercus elegans flavellus*, a sub-species closely associated with River Red Gum riverine forests (Forshaw and Cooper 1981), was commonly seen in Berry Jerry SF but was not seen in The Rock NR, while the Peregrine Falcon *Falco peregrinus* was more frequently recorded at The Rock NR, where it used cliff faces for roosting and nesting, than at Berry Jerry SF, where it was recorded visiting on only a single occasion.

Comparison of the results from 1995-2003 with 1975-1981 provides an opportunity to consider possible temporal changes in the bird communities of the two study areas. However, many of the bird species recorded in this study have mobile habits, including seasonal migrants such as the Rainbow Bee-eater *Merops ornatus* and Olive-backed Oriole *Oriolus sagittatus*, blossom nomads such as the Red Wattlebird *Anthochaera carunculata* and Fuscous Honeyeater *Lichenostomus fuscus*, irregular visitors such as the Masked Woodswallow *Artamus personatus* and White-browed Woodswallow *A. superciliosus*, occasional visitors from more mesic eastern forests such as the Satin Flycatcher *Myiagra cyanoleuca* and Bassian Thrush *Zoothra lunulata* and various raptor species with large home ranges. Confidently demonstrating likely absence of mobile species from a given area is problematic, and it is considered likely that many of the mobile species recorded in 1975-1981 but not 1995-2003 would still occur in the study areas on an irregular basis. To demonstrate this point, although no records of the Little Eagle *Hieraetus morphnoides* were obtained from Berry Jerry SF during 1995-2003, an individual was seen just 3 km north in Currawananna SF (Fig. 1) (Murphy pers. obs. July 2003). Some of the mobile bird species which are thought to be declining or potentially at risk of decline in the NSW South Western Slopes region, such as the Whistling Kite *Haliastur sphenurus* (The Rock NR) and Brown Goshawk *Accipiter fasciatus* (Berry Jerry SF), may have indeed permanently

disappeared from these study areas, but the survey effort in this study was not sufficient to provide certainty in this regard.

The survey effort (including reference to secondary sources) was sufficient to allow more confidence when considering possible temporal changes with respect to sedentary species resident in the study areas. Concentrating on the declining woodland species category, it appears that four species (one fifth of the original declining woodland bird community) may have been lost from Berry Jerry SF at some time over the last two decades: the Speckled Warbler *Chthonicola sagittata*, Eastern Yellow Robin *Eopsaltria australis*, White-browed Babbler *Pomatostomus superciliosus* (Fig. 5) and Diamond Firetail *Stagonopleura guttata*. All four species were targeted during the latter part of the 1999-2003 field survey without success, including searches of sites of earlier records from 1975-1981. These four species were also absent from a list of birds recorded in Berry Jerry SF in 1994-1996 by Bos and Lockwood (1996). Possible reasons for the apparent disappearance of the four species from Berry Jerry SF include grazing impacts, weed invasion, predation by feral cats *Felis catus* and avian nest predators and extinction debt. All four species are predominantly ground feeding (Barker and Vestjens 1979; Read 1994; Tzaros 1996; Antos and Bennett 2006), and all are likely to be sensitive to changes to the understorey and ground cover. Grazing and trampling of woodlands by domestic stock results in a simplified vegetation understorey structure (Tasker and Bradstock 2006) with an increased proportion of introduced weeds (Benson 1991; Burrows 1999) and decreased diversity of ground-living invertebrates (Bromham *et al.* 1999). Gall (1982) noted the adverse impact of stock grazing in Berry Jerry SF and recommended that stock be permanently withdrawn from the reserve. However, Berry Jerry SF has a high proportion of introduced weeds in the ground layer (Burrows 1999), and Forests NSW has opted for a strategic grazing approach as described above. Grazing management practices in Berry Jerry SF need to be closely monitored and adjusted where necessary to ensure they



Fig. 5. White-browed Babbler *Pomatostomus superciliosus*: a declining woodland bird species. Photo by Michael Murphy.

provide benefit to the reserve's woodland bird community.

Comparing the results from the first (1977-1981) and second (1998-2001) national bird Atlases coordinated by the Royal Australasian Ornithological Union (now Birds Australia), Barrett and Silcocks (2002) concluded that the Diamond Firetail was declining in the NSW South Western Slopes region, while the Speckled Warbler population was stable and the Eastern Yellow Robin and White-browed Babbler were increasing. However, while they do remain locally common in some parts of the region, all four species have been found to be locally declining in other parts of the region (Reid 1999). The woodland birds going locally extinct can vary from one location to the next (Reid 2000), and such local-scale patterns may be difficult to discern at a regional spatial scale.

In contrast to Berry Jerry SF, with the possible exception of one species (the

Whistling Kite as noted above), the community of declining woodland birds in The Rock NR was found to remain intact between 1975-1981 and 1995-2003, including all four species missing from Berry Jerry SF. Nevertheless, because of the reserve's small size, there remains a significant risk that some sedentary woodland bird species may disappear from there in the future, particularly if isolation of the reserve increases. Four of the six threatened bird species recorded in The Rock NR during the 1999-2003 field survey were classified as rare, suggesting that resident populations of these species were only small. The Hooded Robin *Melanodryas cucullata* is of particular concern, recorded only on a single occasion during the 1999-2003 field survey. The Hooded Robin is apparently unable to maintain viable populations in isolated areas of habitat smaller than 100-200 ha (Egan *et al.* 1997; Fitri and Ford 1997; Traill and



Rufous Songlark *Cincloramphus mathewsi*: a woodland bird species at risk of future decline. Photo by Michael Murphy.

Duncan 2000). Given that the total area of The Rock NR is only 341 ha, with about half of this comprising steep slopes and ridgetops, the area of suitable habitat available within the reserve may not be sufficient to maintain a viable population of this species. Fortunately, despite extensive clearing in the local area, The Rock NR is not completely isolated, and the area of woodland habitat available within the reserve is currently complemented by additional areas on adjoining freehold properties and a travelling stock reserve, and by (sometimes tenuous) linkages to other small remnants in the local area. Actively supporting and encouraging the protection, management and restoration of these additional habitat areas and local linkages is probably critical to the viability of the Hooded Robin and many other woodland bird populations within the reserve. Restoring habitat connectivity between The Rock NR and nearby larger remnants such as Berry Jerry SF (21 km north) and Livingstone National Park (24 km south-east) (Fig. 1) would be a worthwhile longer-term goal, although likely to prove challenging.

A study of the bird community of another local woodland remnant, Pomingalarna Park (Fig. 1), provided results with similarities to the present study. A field survey in this 225 ha woodland remnant in 1992-1997 (Murphy 1999) recorded 25 declining woodland bird species (including six threatened species). Declining woodland birds observed at Pomingalarna Park, but not recorded at either Berry Jerry SF or The Rock NR, included the Brown Quail *Coturnix ypsilophora*, Crimson Chat *Ephthianura tricolor*, Gilbert's Whistler *Pachycephala inornata* (vulnerable under TSC Act) and White-backed Swallow *Cheramoeca leucosternus* (Murphy 1999). The present study, together with the Pomingalarna study, provides useful reference information for future assessment of changes in the status of species in the Wagga Wagga area. Comparison with the earlier work by Gall (1982) illustrates how such studies can be used to examine possible changes in bird communities over time. Site-based studies of this type are a useful approach to understanding the local details of large-scale patterns such as the regional decline of woodland birds. A re-examina-

tion of the bird communities of Berry Jerry SF and The Rock NR (and Pomingalarna Park) in 2020 would be worthwhile.

Conclusion

The present study found that species in the 'declining' and 'at risk' categories made up about two thirds of the terrestrial bird communities of both Berry Jerry SF and The Rock NR. The loss of this many species from these areas would be devastating. Recher (1999) warned that losses of this intensity were likely at a continental scale, predicting that half of Australia's terrestrial bird species could be extinct by 2100 as a result of continuing ecologically unsustainable human activities. Major coordinated and strategic landscape recovery works are required if Recher's dire future is to be avoided. The NSW South Western Slopes region has already been over-cleared (State of the Environment Advisory Council 1996; Pressey *et al.* 2000), to the extent that even single trees remaining in paddocks are considered of notable ecological significance (Gibbons and Boak 2002). History shows that we are still paying the extinction debt from past land clearing practices. The clearing undertaken, as you read this paper, will be paid for with local species extinctions in 50 years' time. A 'no net loss' approach to the management of native vegetation is not sufficient and will see the current *status quo* of gradual decline continue. A 'net gain' approach to vegetation management is essential to reverse the decline. Surviving remnants of native vegetation need to be protected, and remnants particularly significant because of their size, strategic location or unique value need to be identified and their management improved. Strategic regeneration and restoration is needed to expand the size of existing remnants and to restore connectivity across the landscape. Research into the status of woodland birds and other biodiversity components at a regional and local scale needs to be supported, including monitoring of the effectiveness of restoration efforts so that they can be refined as necessary. The above work must be done in partnership with landholders and local community groups if it is to succeed. Various biodiversity conservation and

landscape restoration projects and initiatives are already underway in many districts, but much work remains to be done. The agricultural productivity of the NSW South Western Slopes region is an economic resource of national significance and the restoration of the region to ecological sustainability warrants substantial national attention and support.

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Appendix.

Bird species recorded from Berry Jerry SF and The Rock NR. Status in 1999-2003 field survey by author: A = abundant; C = common; U = uncommon; R = rare. 3 = record from Gall (1982); @ = record from Atlas of NSW Wildlife. # = record from the Birding-Aus internet mailing list archive. (T) = species currently listed as threatened under NSW *Threatened Species Conservation Act* 1995. * = introduced species. Species names follow Christidis and Boles (1994).

Species		Berry Jerry SF		The Rock NR	
		1975-1981	1995-2003	1975-1981	1995-2003
Category 1: species of aquatic habitats					
Australian Shelduck	<i>Tadorna tadornoides</i>		R		
Australian Wood Duck	<i>Chenonetta jubata</i>	3	C	3	R
Pacific Black Duck	<i>Anas superciliosa</i>	3	C		
Grey Teal	<i>Anas gracilis</i>	3	U		
Domestic Goose	<i>Anser anser</i> *		U		
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>		U		
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>		R		
Great Cormorant	<i>Phalacrocorax carbo</i>	3	R		
Australian Pelican	<i>Pelecanus conspicillatus</i>		U		
White-faced Heron	<i>Egretta novaehollandiae</i>	3	U		R
Australian White Ibis	<i>Threskiornis molucca</i>	3			
Straw-necked Ibis	<i>Threskiornis spinicollis</i>		U		
Yellow-billed Spoonbill	<i>Platalea flavipes</i>		R		
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	3			
Masked Lapwing	<i>Vanellus miles</i>			3	R
Black-fronted Dotterel	<i>Elseya melanops</i>	3			
Category 2: declining woodland species					
Whistling Kite	<i>Haliastur sphenurus</i>	3	R	3	
Painted Button-quail	<i>Turnix varia</i>	3	R	@	U
Peaceful Dove	<i>Geopelia striata</i>	3	C	3	C
Little Lorikeet	<i>Glossopsitta pusilla</i>		R		
Superb Parrot	<i>Polytelis swainsonii</i> (T)	3	R		
Turquoise Parrot	<i>Neophema pulchella</i> (T)			@	R
Brown Treecreeper	<i>Climacteris picumnus</i> (T)	3	C	3	U
Speckled Warbler	<i>Chthonicola sagittata</i> (T)	@		3	U
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>			@	R
Southern Whiteface	<i>Aphelocephala leucopsis</i>				R
Jacky Winter	<i>Microeca fascians</i>		R	3	U
Red-capped Robin	<i>Petroica goodenovii</i>		R	3	C
Hooded Robin	<i>Melanodryas cucullata</i> (T)			3	R
Eastern Yellow Robin	<i>Eopsaltria australis</i>	@		3	C
Grey-crowned Babbler	<i>Pomatostomus temporalis</i> (T)				R
White-browed Babbler	<i>Pomatostomus superciliosus</i>	3		3	C
Varied Sittella	<i>Daphoenositta chrysoptera</i>	@	R	3	C
Crested Shrike-tit	<i>Falcunculus frontatus</i>	3	R	3	R
Rufous Whistler	<i>Pachycephala rufiventris</i>	3	U	3	U
Restless Flycatcher	<i>Myiagra inquieta</i>	3	U	3	U
Masked Woodswallow	<i>Artamus personatus</i>		U		U
White-browed Woodswallow	<i>Artamus superciliosus</i>		U		U
Dusky Woodswallow	<i>Artamus cyanopterus</i>	3	U	3	C
Apostlebird	<i>Struthidea cinerea</i>				U
Double-barred Finch	<i>Taeniopygia bichenovii</i>				#
Diamond Firetail	<i>Stagonopleura guttata</i> (T)	3		3	R
Category 3: woodland/forest species at risk of decline					
Brown Goshawk	<i>Accipiter fasciatus</i>	3		@	@
Little Eagle	<i>Hieraaetus morphnoides</i>	3		3	@
Australian Hobby	<i>Falco longipennis</i>		R	3	R
Peregrine Falcon	<i>Falco peregrinus</i>		R	@	U
Common Bronzewing	<i>Phaps chalcoptera</i>	@		3	U

Appendix 1 cont'd.

Crimson Rosella	<i>Platycercus elegans elegans</i>			3	
Yellow Rosella	<i>Platycercus elegans flaveolus</i>	3	C		
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>			3	@
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>			@	R
Shining Bronze-Cuckoo	<i>Chrysococcyx lucidis</i>			3	
Southern Boobook	<i>Ninox novaeseelandiae</i>		U	@	U
Tawny Frogmouth	<i>Podargus strigoides</i>	3	U	@	
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>			3	R
Sacred Kingfisher	<i>Todiramphus sanctus</i>	3	U	@	U
Dollarbird	<i>Eurystomus orientalis</i>	3	R		
White-throated Treecreeper	<i>Cornobates leucophaeus</i>			3	C
Spotted Pardalote	<i>Pardalotus punctatus</i>	@	U	3	U
Striated Pardalote	<i>Pardalotus striatus</i>	3	U	3	R
Weebill	<i>Smicrornis brevirostris</i>	@	R	3	@
Western Gerygone	<i>Gerygone fusca</i>		U	@	R
White-throated Gerygone	<i>Gerygone olivacea</i>				R
Inland Thornbill	<i>Acanthiza apicalis</i>			3	@
Striated Thornbill	<i>Acanthiza lineata</i>			3	
Brown Thornbill	<i>Acanthiza pusilla</i>			3	U
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>			3	U
Yellow Thornbill	<i>Acanthiza nana</i>			3	C
Red Wattlebird	<i>Anthochaera carunculata</i>	3		@	
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>	3		@	
Little Friarbird	<i>Philemon citreogularis</i>	3	U	@	
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>				R
Grey-fronted Honeyeater	<i>Lichenostomus plumulus</i>	3			
Fuscous Honeyeater	<i>Lichenostomus fuscus</i>	3		@	U
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>		R	3	R
Scarlet Robin	<i>Petroica multicolor</i>	@	R	3	R
Flame Robin	<i>Petroica phoenicea</i>	3	R	3	R
Golden Whistler	<i>Pachycephala pectoralis</i>	@	R	3	R
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	3	C	3	C
Leaden Flycatcher	<i>Myiagra rubecula</i>				@
Satin Flycatcher	<i>Myiagra cyanoleuca</i>			@	
Grey Fantail	<i>Rhipidura fuliginosa</i>	3	U	3	C
White-winged Triller	<i>Lalage sueurii</i>		R		@
Olive-backed Oriole	<i>Oriolus sagittatus</i>		R	@	
Grey Butcherbird	<i>Cracticus torquatus</i>		R	3	
White-winged Chough	<i>Corcorax melanorhamphos</i>	3	C	3	C
Red-browed Finch	<i>Neochmia temporalis</i>			3	R
Mistletoebird	<i>Dicaeum hirundinaceum</i>		R	@	R
Tree Martin	<i>Hirundo nigricans</i>	3	U		R
Rufous Songlark	<i>Cincloramphus mathewsi</i>	3	R	@	R
Silvereye	<i>Zosterops lateralis</i>			3	R
Bassian Thrush	<i>Zoothera lunulata</i>			3	

Category 4: agricultural species

Black-shouldered Kite	<i>Elanus axillaris</i>		R	@	
Wedge-tailed Eagle	<i>Aquila audax</i>	3	R	3	R
Brown Falcon	<i>Falco berigora</i>				R
Nankeen Kestrel	<i>Falco cenchroides</i>	3	R	@	R
Rock Dove	<i>Columba livia</i> *			3	
Crested Pigeon	<i>Ocyphaps lophotes</i>	3	U	3	C
Galah	<i>Cacatua roseicapilla</i>	3	A	3	C
Little Corella	<i>Cacatua sanguinea</i>				U
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	3	A		U
Cockatiel	<i>Nymphicus hollandicus</i>	3			
Eastern Rosella	<i>Platycercus eximius</i>	3	C	3	C
Red-rumped Parrot	<i>Psephotus laematonotus</i>	3	C	3	U
Barn Owl	<i>Tyto alba</i>	3			
Laughing Kookaburra	<i>Dacelo noveaguineae</i>	3	C	3	U
Rainbow Bee-eater	<i>Merops ornatus</i>	3		3	U
Superb Fairy-wren	<i>Malurus cyaneus</i>		U	3	U
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	3	R	3	U

Appendix 1 cont'd.

Noisy Miner	<i>Manorina melanocephala</i>	3	U	3	U
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	3	C	3	C
Magpie-lark	<i>Grallina cyanoleuca</i>	3	C	3	U
Willie Wagtail	<i>Rhipidura leucophrys</i>	3	C	3	C
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	3	U	(@)	U
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	3	R		R
Black-faced Woodswallow	<i>Artamus cinereus</i>				(@)
Pied Butcherbird	<i>Cracticus nigrogularis</i>			(@)	(@)
Australian Magpie	<i>Gymnorhina tibicen</i>	3	C	3	C
Pied Currawong	<i>Strepera graculina</i>	3	R	3	U
Australian Raven	<i>Corvus coronoides</i>	3	C	3	U
Little Raven	<i>Corvus mellori</i>	3	U	3	C
Richard's Pipit	<i>Anthus novaeseelandiae</i>				(@)
Zebra Finch	<i>Taeniopygia guttata</i>			3	
European Goldfinch	<i>Carduelis carduelis</i> *			3	
Welcome Swallow	<i>Hirundo neoxena</i>	3	C	(@)	R
Fairy Martin	<i>Hirundo ariel</i>	3	U		R
Brown Songlark	<i>Cincloramphus cruralis</i>			(@)	(@)
Common Starling	<i>Sturnus vulgaris</i> *	3		3	R
Total species (separate survey periods)		70	75	89	92
Total species (surveys combined)			93		108

One Hundred Years Ago

THE NEGATIVE PHOTOTAXIS OF BLOW-FLY LARVAE.

by Prof. A.J. Ewart, Ph.D., D.SC., F.L.S., &c.

On moving a heap of manure recently many thousands of active maggots were left behind, and it was noticed that these immediately began to crawl rapidly towards some loose earth lying at the foot of a tree, in which they buried themselves, traversing a distance of 5 to 12 feet before doing so. The phenomenon was a remarkable one, since hundreds of the larvae could be seen crawling rapidly in an almost straight course for the base of the tree, without a single one progressing in the opposite direction or diverging to any extent laterally. That the movement was not directed by ordinary vision or by smell is shown by the fact that a piece of manure placed within an inch of the maggots on the outward side did not attract them, and that they passed such heaps unnoticed unless they were actually in their path. In the latter case the larvae at once buried themselves in the heap. The path of movement towards the tree was slightly down hill, but on changing the position of the grubs they crawled up hill towards the same destination, and also crossed a ridge of hard soil placed across their downward path. Evidently, therefore, the response is not a geotropic one.

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